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The Effectiveness of Basic Physics Experiment Module Based on Guided Inquiry Model in Improving Hard Skills and Soft Skills of Prospective Physics Teachers

by Herman Jufri Andi

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THE EFFECTIVENESS OF BASIC PHYSICS EXPERIMENT MODULE BASED ON GUIDED INQUIRY MODEL IN IMPROVING HARD SKILLS AND SOFT SKILLS OF PROSPECTIVE PHYSICS TEACHERS

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ABSTRACT

The purpose of this research is to identify the effectiveness of the first basic physics practice module based on guided inquiry on improving students' hard skills and soft skills. The experimental design is "One Group Pretest-Potteest Control Groups Design". The samples of the research are the students who take the first basic physics practice. Data analysis techniques were effect size and gain score. Based on the result of the research, it was found that the improvement of hard skills and soft skills of the students reached 0.49 and 0.61 which was categorized as moderate. For effect size obtained data of 2.65 and 3.61 for hard skills and soft skills are categorized very high. It can be concluded that the effectiveness of the use of the first basic physics practice module based on guided inquiry is very significant to improve hard skills and soft skills of the students.

ABSTRAK

Tujuan penelitian ini untuk mengidentifikasi keefektifan penggunaan panduan praktikum fisika dasar 1 berbasis guided inquiry terhadap peningkatan hard skills dan soft skills mahasiswa. Desain eksperimen yang digunakan adalah One Group Pretest-Postest Control Groups Design. Sampel penelitian adalah mahasiswa yang menempuh praktikum fisika dasar 1. Teknik analisis data yang digunakan adalah effect size dan gain score. Berdasarkan hasil penelitian diperoleh peningkatan hard skills dan soft skills mahasiswa mencapai 0.49 dan 0.61 yang berkategori sedang. Hal ini menunjukkan bahwa penggunaan panduan praktikum fisika dasar 1 dapat meningkatkan hard skills dan soft skills mahasiswa. Untuk uji effect size diperoleh data sebesar 2.65 dan 3.61 untuk hard skills dan soft skills yang berkategori tinggi. Dari hasil penelitian dapat disimpulkan bahwa kefektivitas penggunaan modul panduan praktikum fisika dasar 1 berbasis guided inquiry sangat efektif untuk meningkatkan hard skills dan soft skills mahasiswa.

Keywords: Guided Inquiry; Hard Skills; Soft Skills

INTRODUCTION

One of the efforts to improve the quality of education in Indonesia is by improving teaching and learning processes in all levels of education. There are some elements to improve the quality of education in Indonesia, such as curriculum, educational content, learning process, evaluation, teacher quality, facilities and infrastructure as well as textbooks.

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Curriculum development is very important to improve the quality of education in order to produce graduates who are competent in their field. The curriculum development should encourage the formation of hard skills and soft skills. Hard skills is the ability to apply concepts, methods, and evaluations to improve the skills of learners. While soft skill is including the ability to communicate, work together in teams, leadership and problem-solving skills. Rosima & Melati (2012) stated that both skills (hard skills and soft skills) can be achieved in practical activities.

Rustaman in Purwaningsih (2014) desc-

ribed that practice has several purposes: (1) to motivate students because the practice generally attracts students so they are motivated to learn science; (2) to teach basic scientific skills, (3) to improve understanding of concepts, (4) to understand and to use scientific methods, (5) to develop scientific attitudes. Meanwhile, according to Hodson in Abrahams (2011) there are 5 purposes of practical activities, they are: (1) to increase scientific knowledge, (2) to teach experimental skills, (3) to develop 'scientific attitude' like open minded, objective , and willingness to suspend judgment, (4) to develop skills, and to provide assessments, and (5) to motivate learners, with interesting and fun simulations. By doing practical activity students will be motivated, skilled and easy to understand the concept in physics learning.

Learning process contains 3 elements, namely attitude, knowledge, and skill. The final result of the development of these three element are that the learners have soft skill and hard skills. One way to achieve that ability is to carry out the practice well and correctly. To make sure that the practice will run well, one of the requirements is a practical guide module. According to Budi (2011) the practical guide module is a guideline for the implementation of a practice that contains the procedures for preparations, implementation, data analysis and report which is prepared by a person or group of teaching staff who handle the practice and follow the rules of scientific writing.

But in fact, even though there is a first basic physics practice module, there were only 1 until 3 students from 30 students of class 2015 who were able to formulate problems, to create hypotheses, to determine control, manipulate and response variables. While the ability to analyze and summarize the results of observations are also still less precise. Students always enter the basic theory or the results of observation while they were taking conclusions, whereas according to Riduwan, (2008) if we want to make a good conclusion, it is briefly expressed clearly and easily understood and must be in line and accordingly. It is not only hard skills are still low but also in soft skills found in this study. It is observed when the students communicate the results of the report, teamwork discussion, tenacity and curiosity of students in doing the first basic physics practice, but there is still one soft skill that is good, is honesty

The weakness of hard skills and soft skills of physics education students of Teacher and Education Faculty, Madura Islamic University of is caused by several factors such as the input of physics students. Most of them were come from from senior high school/vocational/ MA with various majors. Students from SMA/ MA, they have experience in learning Science. Social Science and language, while the students who came from vocational school, they have other majors. Based on the reason the students' hard skills about physics subject are still low.

In addition, practical activities emphasize more on the outcome (product) rather than on the process, so that few opportunities are given to the students to do some experiences based on their own efforts in developing hard skills and soft skills. Whereas as a candidate of future teacher who will teach physics highschool students, they need more experience and develop their scientific work skills. So that, later they can guide students to perform independent experiments in learning science in school, gain knowledge, which will make it easier to test, modify, to change the initial ideas that have been owned, and to adopt new ideas as well as to encourage the development of hard skills and soft skills of their students. Based on the results of the study the first basic physics lab used by physics education students FKIP Islamic University of Madura does not encourage students to train their hard skills and soft skills. This is because the first basic physics is still conventional with the guidance of the prescription model (cook book) so that the students are less active in the lab activities.

One of the efforts to solve these problems is to develop the first basic physic practice module based guided inquiry. The selection of the module development gave the advantages of guided inquiry that can form the student's "Self Concept", develop individual talents or abilities, giving students the freedom to study. Guided inquiry is one type of inquiry learning. Teachers were provide problems to be investigated along with the tools and materials to be used for experiments, but students plan themselves a procedure to solve the problem.

Guided inquiry can train learners to build answers and think smartly in finding various alternative solutions to the problems raised by educators; develop conceptual understanding skills; build a sense of responsibility; and train the process of conveying the concept found (Bilgin, 2009). Meanwhile, based on research Ariesta & Supartono (2011) it s found that the form of lectures of basic physics laboratory 2

activities based on guided inquiry learning model can improve the scientific work of students. It is in line with the results of Nengsi (2016) research that the guidance of general biology-experiment based on guided inquiry learning model for biology students of STKIP Payakumbuh was valid, practical, and effective. This is apparent in the activities of students who are active in conducting practical activity using guided inquiry guide. The same opinion was also shown in a study conducted by Nurussaniah (2016) which concluded that there was an increase in students' critical thinking skills after using the first basic physics practice module based on guided inquiry categorised of medium with a N-gain value of 0.64.

Based on the above description it is necessary to improve hard skills and soft skills of prospective physics teacher through the first basic physics practice module based on guided inquiry.

METHOD

This research was conducted in two stages, the first phase was the development of the first basic physics module based on guided inquiry using the modified Borg & Gall (2003) development model and the second stage was the experiment in the class, in the implementation the first basic physics module based of guided inquiry. In the first stage, developed the first basic physics practice module based on guided inquiry which has been validated by experts in the field of education and has been tested on a small scale. The results of the validation of the experts stated that the first basic physics practice module based on guided inquiry is very significant to use.

In the second phase of large-scale, experiments using experimental research. The experimental design used was "One Group Pretest-Postest Control Groups Design" (Schreiber, 2011). This research was conducted at the integrated laboratory of Madura Islamic University. The population in this study are all students of physics education program of Madura Islamic University, while the research sample is students in Odd Semester Academic Year 2017-2018 which take the course of the first basic physics practice. The instrument used in this research is an expert validation sheet on the first basic physics practice module based on guided inquiry, hard skills assessment sheet and student soft skills, students' response and questionnaire.

Analysis of the result of hard skills assessment and soft skills of students were conducted by using gain score test. A normalized gain score test is a good method for analyzing pre-test and post-test results. N-Gain Score is a good indicator to show the level of effectiveness by analyzing pre-test score and post-test scores. By adapting Hake's theory of a normalized gain score, the effectiveness of the use of guided inquiry guidelines in the first basic physic practice module based on guided inquiry on hard skills and soft skills of students could be determined.

To find out the improvement of hard skills and soft skills of students in the subject of the first basic physics practice used the average score data <g> processed by using the equation developed by Hake (1999), as follows.

$$\langle g \rangle = \frac{\langle S_{post} \rangle - \langle S_{pre} \rangle}{S_{ideal} - \langle S_{pre} \rangle} \quad (1)$$

The <g> category is presented in Table 1

Table 1. Category Level <g>

LIMITATION OF N-GAIN	CATEGORY
<G> > 0.70	HIGH
0.30 ≤ <G> ≥ 0.70	MEDIUM
<G> < 0.30	LOW

Effect size is calculated using the formula (Cohen, 1998) as follows,

$$d = \frac{M_{posttest} - M_{pretest}}{\sqrt{\frac{SD^2_{posttest} + SD^2_{pretest}}{2}}} \quad (2)$$

where:

M : : Average test scores

SD : : Standard deviation test scores

The value of the effect size (d) obtained is interpreted using the following Cohen (1998) criteria:

Table 2. Interpretation effect size

Effect size	Interpretation
d < 0.2	Very small
0.2 ≤d < 0.5	Small
0.5 ≤d < 0.8	Medium
0.8 ≤ d<1.0	Big
d ≥ 1.0	Very large

RESULTS AND DISCUSSION

Module validation analysis

The module developed in this research is the first basic physic practice module. This module has been validated by 4 expert lecturers working in education. The result of the evaluation of the first basic physics practice module prisented in Figure 1.

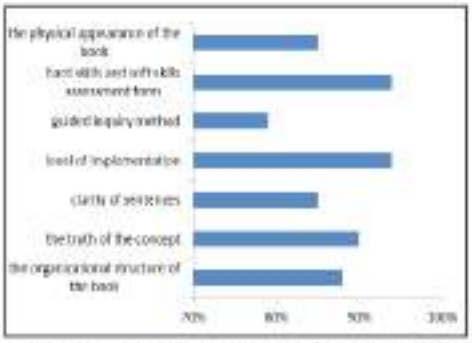

Figure 1. Result of validator's evaluation of the first basic physic practice module

Based on Figure 1 above it appears that the average percentage of the first basic physics practice module based on guided inquiry is 88%. This indicates that the overall module of this practical guide has been significant to be used as a guideline for students and lecturers in practicing the first basic physic practice. However there are some aspects that need to be improved in the steps of guided inquiry method.

Analysis of hard skills and soft skills improvement of students

Pretest and posttest results data of hard skills and soft skills achieved by students can be described statistically as shown in Table 3.

Table 3. Descriptive statistics pretest-posttest mean hard skills and soft skills of students

Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation
pretest_hardskills	24	3.0	3.9	3.346	.1911
pretest_softskills	24	3.6	4.1	3.804	.1628
posttest_hardskills	24	3.5	4.7	4.012	.3207
posttest_softskills	24	4.0	4.7	4.354	.1693

In Table 3 it appears that the average pretest score in hard skills has a minimum value of 3.0 and a maximum of 3.9 while the mean value obtained is 3.3. This shows that the average score of pretest student hard skills is in pretty good category. While the soft skills have a minimum value of 3,6 and a maximum of 4,1 with a mean of ,8. This shows that the average value of pretest soft skills is in good category. For a minimum average posttest score of hard skills is 3,5 and a maximum of 4.7 with an average value of 4,0. This shows that the average value of posttest hard skills is in 3.4 ≤ good < 4.2 category. As for the minimum score average student skill is 4.0 with a maximum of 4.7 and an average value of 4.4. This indicates that on the posttest the students' soft skill score is in the 4.2 ≤ excellent ≤ 5.0 category.

Table 3 shows the differences in student hard skills and soft skills during pretest and posttest. Where at posttest value hard skills and soft skills of student is higher than with pretest mean value. Meanwhile, to know the category of increasing the average score of hard skills and soft skills of students can be seen in Table 4 and Table 5. While improving hard skills and soft skills can be seen in Figure 2.

Table 4. The average score of students' hard skills

Pre	Post	<g>	No	Pre	Post	<g>
3.0	3.8	0.47	13	3.3	3.8	0.36
3.3	3.9	0.43	14	3.4	4.7	1.00
3.1	3.7	0.38	15	3.3	4.2	0.64
3.9	4.7	1.00	16	3.3	3.8	0.36
3.4	4.0	0.46	17	3.2	3.6	0.27
3.5	3.9	0.33	18	3.4	4.4	0.77
3.6	3.9	0.27	19	3.3	4.0	0.50
3.6	4.3	0.64	20	3.3	4.0	0.50
3.4	4.0	0.46	21	3.4	4.4	0.77
3.4	3.9	0.38	22	3.2	3.5	0.20
3.0	3.6	0.35	23	3.3	4.2	0.64
3.4	3.8	0.31	24	3.3	4.2	0.64
The average score of hard skills				3.3	4.0	0.49

Based on Table 4 it appears that there are 4 students have hard skills improvement which high category that has value (<g>)> 0.70 while the other 20 students have hard skills increase which is being with hard skills increase in classical reach 0.49 which is categorized moderate (0.30 ≤ <g> ≤ 0.70). This indicates that the first basic physic practice based on guided inquiry can improve the hard skills of prospective physics teacher.

Table 5. The average score of students' soft skills

Pre	Post	<g>	No	Pre	Post	<g>
3.6	4.2	0.55	13	3.8	4.2	0.44
3.9	4.3	0.50	14	3.6	4.7	1.00
3.8	4.3	0.56	15	3.8	4.3	0.56
4.1	4.7	1.00	16	3.6	4.0	0.36
4.0	4.4	0.57	17	3.8	4.2	0.44
3.9	4.2	0.38	18	3.7	4.5	0.80
4.1	4.4	0.50	19	3.8	4.2	0.44
4.1	4.4	0.50	20	3.7	4.3	0.60
3.8	4.3	0.56	21	3.6	4.5	0.82
3.7	4.4	0.70	22	3.8	4.3	0.56
4.0	4.4	0.57	23	3.6	4.5	0.82
3.7	4.2	0.50	24	3.8	4.6	0.89
The Average score of Soft skills				3.8	4.35	0.61

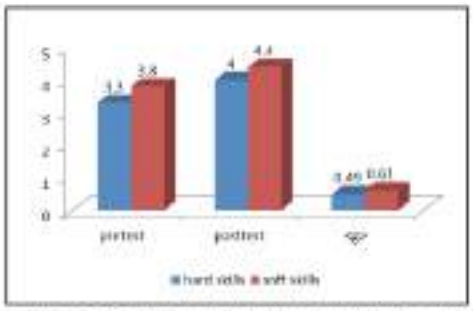

Figure 2. Graphic of the score hard skills and soft skills

This result is in line with the results of Thornton (2005) that in scientific work colleges developed through guided inquiry-based laboratory activities that provide problems to students, lead students to think and to solve the problems given. Scientific work developed through basic physics laboratory activity. In this study have four basic competence standards that are planning research activities, conducting scientific research, communicating the results of scientific research in the form of reports, and being scientific (Depdiknas, 2003).

The same thing is also put forward by Massialas in Matthew & Kenneth (2013) which states that the guided inquiry model is a teaching model that allows students to move step by step from identifying problems, defining hypotheses, formulating problems, collecting data, verifying results, and generalizing conclusions. The improvement in student soft skills is shown in Table 5. The increase in soft skills is high category (g> 70) there are 6 students and in the moderate category (0.30 ≤ g ≤ 70) there are 18 students. The overall increase in soft skills reached 0.61 in the medium category. This shows that the first basic physics practice module based on guided inquiry can improve the soft skills of prospective physics teacher.

Based on Figure 2 above it appears that there is an improvement in hard skills and soft skills of students who each of 0.49 and 0.61 are categorized as being. Although the increase obtained is still in the moderate category, it can be concluded that the use of the first basic physic practice module based on guided inquiry can improve hard skills and soft skills of prospective physics teacher.

This is consistent with statement of Gulo (2002) that the process of inquiry learning models not only develops intellectual ability but all of the potential that exists including emotional development and skills. A similar opinion is also expressed by Sulistyorini (2007) that science learning should be conducted in scientific inquiry to cultivate the ability to think, work and be scientific and communicate it as an important aspect of life skills.

The average values of each hard skill attribute and soft skills was presented in Figures 3 and 4.

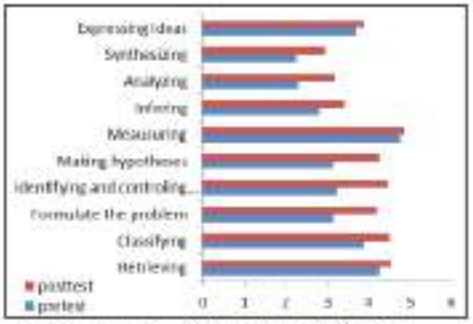

Figure 3. The improvement of hard skills

Based on Figure 3, it appears that pretest of student hard skills in inferencing, analyzing and synthesizing the data of the research results are still in sufficient category (1.8 ≤ Poorly < 2.6) This is because students are still confused by what they will do with the data they have obtained. In Figure 4 it is apparent that the average value of students' pretest soft skills on attribute decision making has the lowest value, this is because students have difficulties in analyzing and synthesizing the result data.

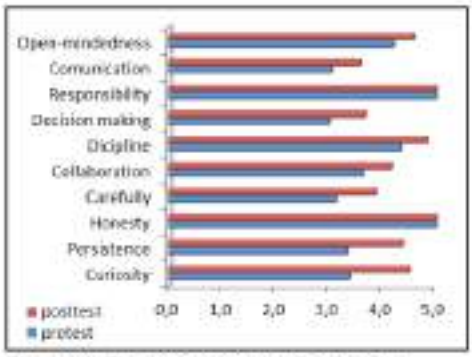

Figure 4. The improvement of soft skills

This is in accordance with the findings, (Trundle, Atwood, Christopher, & Sackes, 2010), (Brickman, Hallar, Gormally, & Armstrong, 2009) (Zawadski, 2009) and (Minderhout & Loertscher, 2007), that students at the beginning of learning did not enjoy guided inquiry-based learning because many of the activities they had to do themselves although at the same time, students' abilities grow and are able to build their own knowledge. While in the formulation of hypothesis students get good criteria, this is because students feel confuse in identifying variables and formulating research problems in accordance with the problems given by lecturers. This is supported by the research of Syafitri (2010) which states that formulating a problem with a background of hypotheses requires a basic knowledge of what is being studied.

Analysis of the effectiveness of the first basic physic practice module on hard skills and soft skills of students

Analysis of the effectiveness of the first basic physics practice module based on guided inquiry was presented in Table 6.

Tabel 6. Test of effectiveness

	Mean	Standart-Deviasi
Pretest hard skill	3.3	.1911
Posttest hard skill	4.0	.3207
Pretest soft skills	3.8	.1628
Posttest soft skill	4.4	.1693
ES (*Effect Size*) hard skills	2.65	
ES (*Effect Size*) soft skills	3.61	

Based on Table 6 it appears th ES (Effect Size) for the use of guided in the first basic physics module based on guided inquiry to hard skill and soft skill are 2.65 and 3.61 his shows that the use of the first basic ph ics module is very effective in improving the hard skills and soft skills of ph ics education students.

The high influence of the use of the first asic physics module to the improvement of hard skills and soft skills of students because the module is based on the guided inquiry syntax, where the self-planned activities of the students provide direct experience and train students' scientific work skills, starting from formulating problems, hypotheses, practical variables and operational definitions, communicate data, analyze data and make conclusions. The first basic physics practice module can help to use basic memories and transfers to new learning situations so that students can understand better basic concepts.

According to Sukmadinata (2013) stated that a meaningful module for students is presented in a form appropriate to students' level of thinking ability, and delivered in an interesting and interactive form that makes students more actively involved in the learning process, thereby generating motivation to learn more long-term students. Maretasari, Subali & Hartono (2012) in his research, stated that learning using laboratory based inquiry model has a positive and significant influence on students 'learning outcomes and students' scientific attitude. The result of research from Mokaromah (2008) in Handayani, Farida, & Anhar (2014) also stated that the development of guidebook of chemistry class chemistry of X class inquired based on inquiry is able to improve students' scientific thinking ability and appropriate to be used as instructional media.

The improvement of student hard skills in this study is moderate. This is because there are still students who have difficulty in expressing the right reasons to answer the problems in the hypothesis column, difficulty in suggesting inference, analyzing and synthesizing the result data of the lab. There are still many students who ask for lecturers or co-ass to answer the problems in the hypothetical column, formulate inference, analyze and synthesize the results of the lab data. To overcome it required repeated exercise to familiarize students doing scientific work.

The same opinion is expressed by Rustaman (2005) which stated that guided inquiry ability can influence the development of student's knowledge. Familiarize students learn through the process of scientific work, in

addition to train details of scientific skills and systematic work, can also form students' scientific thinking patterns.

In the result of improvement of student soft skills in this research also still moderate equal to 0.61. This is because there are still students who have difficulty in cooperating with members of the group, not careful in measuring, and in making decisions are still difficult and some students felt difficult in presenting or communicating the results of practice in front of the class. To overcome these problems it requires repetitive exercise so that students are accustomed to being scientific. The results of this study are also similar to the results of research Arsih (2010) in Syamsu (2017) which also shows that students' attitudes in learning using the guided inquiry-oriented IPA learning devices included in the category very well. This means that students are able to behave scientifically during the course of learning with guided inquiry so that students indirectly have gained experience in learning.

The improvement of hard skills and soft skills also affect the mastery of the first basic physics student concept. Analyzing ability and synthesizing (hard skills) students who are initially low with a value of 2.3 have an impact on mastering the first basic physics concept for example on the subject of density. On the subject, students look for density of a solid object because the ability of analyzing and synthesizing is still low so as to make decision making and communication (soft skills) also less good and assume that the density of objects is influenced by the volume of water, as well as do not understand why volume objects equal to the volume of water transferred. But after using the first basic physics practice module based on guided inquiry improves analyzing ability, synthesizing, decision making, and communication of prospective physics teachers which also affect the mastery of the first basic physics concepts. Students have understood why the density of the immersed object is equal to the transferred and can analyze the factors that influence the results of density measurements.

CONCLUSION

In this research, we have developed the first basic physics practice module to improve hard skills and soft skills of prospective physics teacher. The results of this study shows that the the first basic physics practice module based on guided inquiry model is effective in improving significantly the hard skills and soft skills of students (physics teacher candidate).

Based on the results of the research and discussion and the benefits of this research, there are several suggestion to conduct the similar research as follows: the students should given provisions or exercises about formulating the problem, controlling the variables, making hypotheses, analyzing and synthesizing the data so that they will not have any difficulties in doing the lab work.

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